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Electronic Supplementary Information

Full-solution processed all-nanowires flexible and transparent ultraviolet photodetectors

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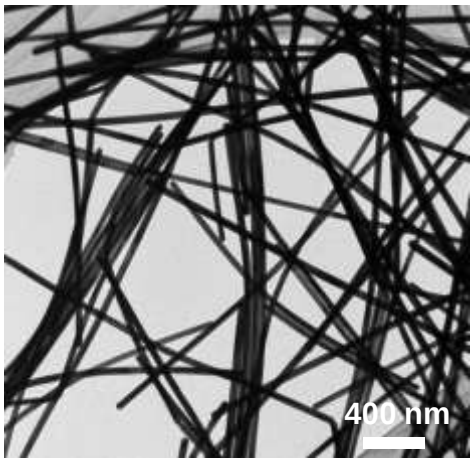

Figure S1 TEM image of Ag NW.

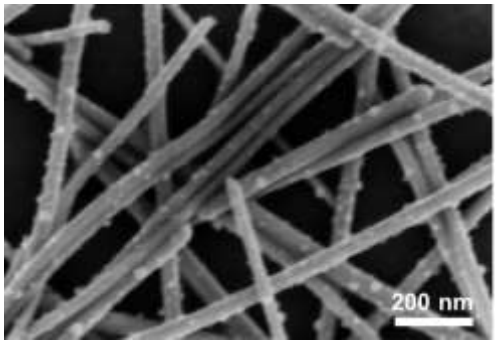

Figure S2 SEM image of ZnO seeds on Ag NW/PET.

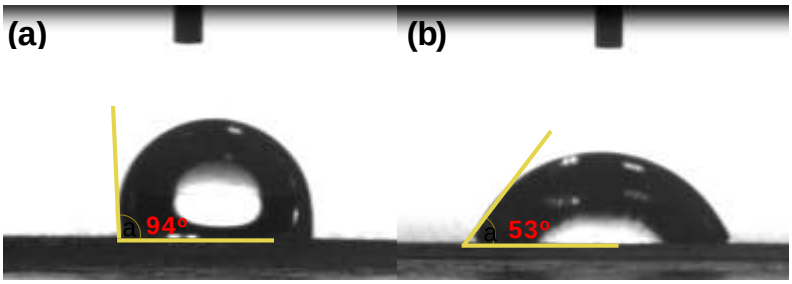

Figure S3 Water contact angles of (a) PET and (b) Ag NW/PET. The water contact angles of different samples were measured with 3 µL droplet of ZnO seed aqueous solution using a Krüss DSA100 (KrüssCompany, Germany) apparatus at ambient temperature. The values of water contact angles for PET and Ag NW/PET are 94° and 53°, respectively. Due to the better surface wettability of ZnO seed aqueous solution for the Ag NW networks compared to the PET, the ZnO seeds are preferentially grown on Ag NW networks (Figure S2).

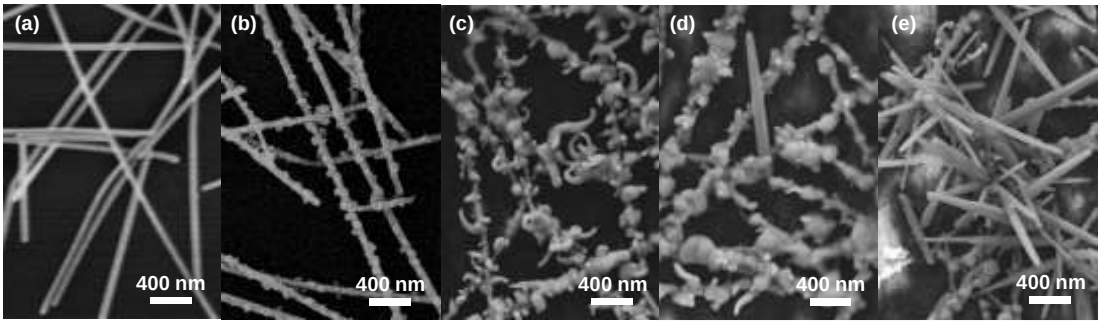

Figure S4 SEM observation of the growth process of ZnO NW. (a) Low-density Ag NW film on PET. (b) As-prepared ZnO seeds on Ag NW/PET. (c-e) ZnO NW with different growth time of 10 (c), 20 (d) and 40 min (e).

A controlled experiment were carried out in order to indicate the the growth process of ZnO NW. First, a low-density Ag NW film was deposited on PET by spray coating. Then, ZnO seeds were grown on Ag NW by spin coating the seed solution on the Ag NW/PET and sequentially annealing at 120 °C for 2 h. Finally, ZnO NW was prepared by placing Ag NW/PET film containing ZnO seeds in the growth solution (a 100 ml of mixing equimolar aqueous solution (2.5 mM) of hexamethylenetetramine and zinc nitrate hexahydrate) and heated at 90 °C with different growth time of 10, 20 and 40 min. The SEM iamges of Ag NW/PET, ZnO seeds/Ag NW/PET and ZnO NW /Ag NW/PET are shown in Figure S4. After the deposition of ZnO seeds, the suface of Ag NW is covered uniformly by the grains of ZnO seeds (Figure S4a and S4b). At the initial growth stage, the as-prepared ZnO seeds grow, coalesce with each other, and link to form the ZnO seeds layer with full coverage on the Ag NW networks (Figure S4c).Then, ZnO NW started to grow on the ZnO seeds layer. As the growth time increased, the length and dendsity of the ZnO NW increase (Figure S4d and S4e). Due to the location effect of ZnO seeds, the ZnO NW are preferentially grown on Ag NW networks.

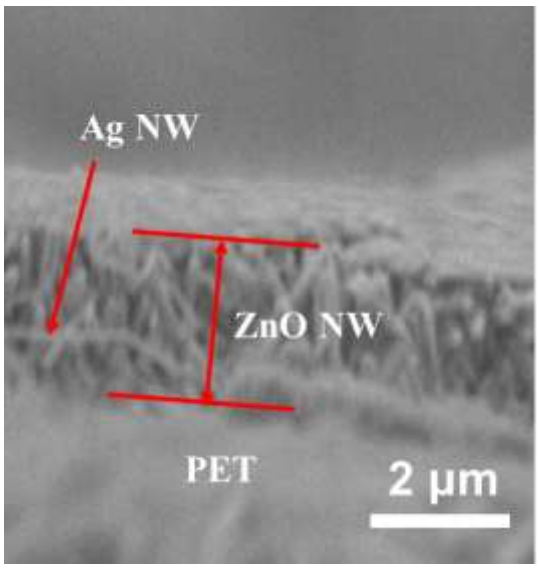

Figure S5 Cross-sectional SEM image of ZnO NW/Ag NW/PET film.

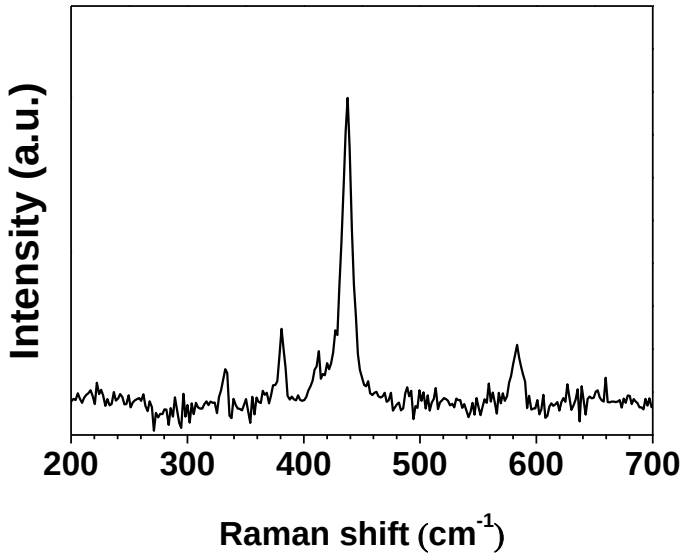

Figure S6 Raman spectrum of the ZnO NW arrays. The sharp peak at 438 cm^{-1} is attributed the high-frequency E_2 mode of the wurtzite ZnO, suggesting the good crystallinity of the as-grown ZnO NW.

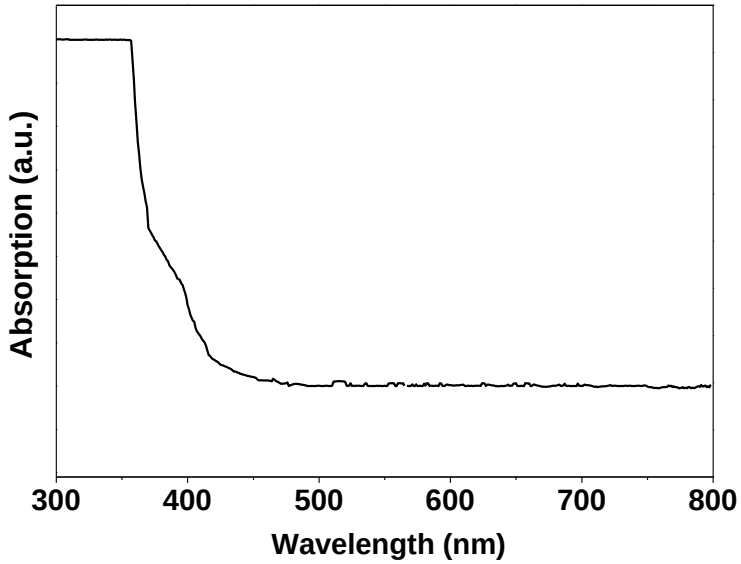

Figure S7 UV-visible light absorption spectrum of the ZnO NW arrays.

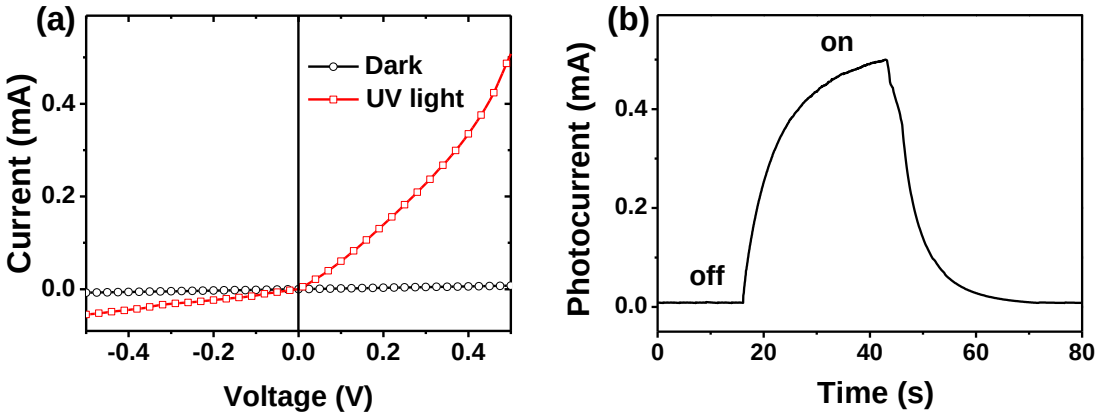

Figure S8 (a) Current-voltage curves of the Ag film/ZnO NW/Ag NW photodetector measured under dark and UV illumination. (b) UV light on/off response of the device at 0.5 V bias. For comparison, the Ag film/ ZnO NW/Ag NW device with thermal-evaporated Ag film top electrode (with thickness of 15 nm and sheet resistance of about 18 Ω sq^{-1}) is fabricated and measured electronic prosperities. At a forward bias of 0.5 V, the dark current of the device is 7.6×10^{-6} A (Figure S8a), which is higher than that of Ag NW/ ZnO NW/Ag NW device (Figure 4a). This result could be attributed to the permeation of Ag into the ZnO NW arrays layer during Ag deposition, leading to the increased conductivity of ZnO NW film. The photocurrent of the device under UV light illumination (0.5 mW/cm^2) is 5.07×10^{-4} A. The calculated I_{on}/I_{off} of device is 67. The t_{rise} and t_{decay} of device exacted from Figure S8 are 15.4 s and 12.2 s, respectively. Compared to Ag NW/ ZnO NW/Ag NW device, the Ag film/ ZnO NW/Ag NW device exhibits the worse performance, which is due to the lower UV light and oxygen transmission as well as absorption of Ag film.

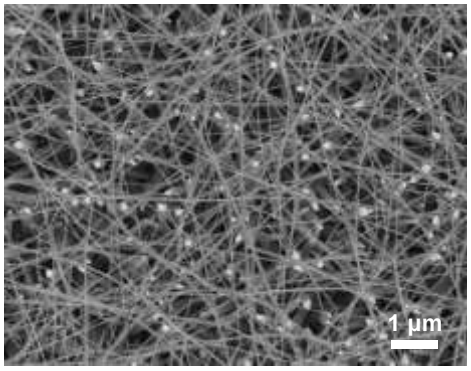

Figure S9 SEM image of Ag NW/ZnO NW/Ag NW device after 6000 bending cycles.